भारतीय मानक
Indian Standard

IS 1725 : 2023

सामान्य भवन निर्माण में प्रयुक्त स्थायीकृत मृदा की ब्लॉक — विशिष्टि

(तीसरा पुनरीक्षण)

Stabilized Soil Blocks Used in General Building Construction — Specification

(Third Revision)

ICS 91.100.25

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Clay and Stabilized Soil Products for Construction Sectional Committee, CED 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Clay and Stabilized Soil Products for Construction Sectional Committee had been approved by the Civil Engineering Division Council.

Soil represents the earliest construction material used by mankind. Pure mud constructions suffer from two major drawbacks, complete loss of strength on saturation and erosion due to rain impact.Soil is therefore stabilized to improve its strength properties and durability and the stabilized soil is used for various engineering applications.

Stabilized soils have been successfully used for the construction of roads, pavements, foundations, earthen bunds, etc, in the past.Use of stabilized soils for the construction of walls of buildings can be seen since thirties.

Further upsurge of interest in the use of stabilized soil blocks for masonry can be seen throughout the world. Large numbers of buildings using stabilized soil blocks have come up in many parts of the world including India. This is mainly attributed to the fact that stabilized soil block is energy efficient and low carbon emission alternative to burnt clay brick and concrete based blocks. Currently large varieties of machines are commercially marketed throughout the world for the production of stabilized soil blocks. Use of these machines has lead to production of stabilized soil blocks of higher compressive strength, proper dimensions and precise edges and has also lead to better block productivity. Both modular and non-modular sizes of stabilized soil blocks are being manufactured in the country.

This standard was first published in 1960 and subsequently revised in 1982 and in 2013. During its first revision the principal modification was in respect of weathering test. The standard had also covered only modular sizes of stabilized soil blocks having a maximum strength of 3 N/mm^2. It was brought to the notice of Committee that there is sufficient demand for sizes other than modular sizes and that the manufacturers were meeting such demands at present. This had lead to a situation where bricks satisfying other requirements of the standard, but not the requirements regarding dimensions were classified as not satisfying the requirements of the standard. Therefore, the Committee reviewed the relevant clause of the standard and decided that the current revision of the standard will also include the non-modular sizes of the blocks in addition to the modular sizes specified in the standard. Vast amount of knowledge and experience accumulated due to the research and development efforts of several organizations throughout the world is also the basis for revising the standard.

During the second revision, the principal modifications were the inclusion of requirement of raw materials for the production of stabilised soil blocks and a guideline on the selection and modification of the soil to ensure good quality stabilized blocks; and the modification/inclusion of more test methods and requirements of the stabilised soil blocks.

The major changes incorporated in this revision are given below:

a) The specific class of lime to be used in the preparation of stabilised soil blocks has been defined.

b) The stabilized blocks have been classified on the basis of their compressive strength.

c) The definition of the sand to be used for the manufacture of stabilized soil blocks have been redefined to include artificial as well as natural sand as per IS 383 : 2016 ‘Coarse and fine aggregate for concrete− Specification (*third revision*)’.

d) The requirement of the actual compressive strength of the stabilized soil blocks for use in specific masonry walls have been included.

e) The procedure for the determination of linear expansion on saturation has been modified.

f) The figure of length comparator has been updated.

The composition of the Committee responsible for formulation of this standard is listed in Annex F.

(*Continued on third cover*)

Indian Standard

STABILIZED SOIL BLOCKS USED IN GENERAL BUILDING CONSTRUCTION — SPECIFICATION

(Third Revision)

1 SCOPE

This standard covers the requirements for general quality, dimensions and physical requirements for solid stabilized soil blocks for use in general building construction.

2 REFERENCES

The standards listed below contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Tittle*
269 : 2015	Ordinary Portland Cement — Specification (*sixth revision*)
383 : 2016	Coarse and fine aggregates for concrete — Specification (*third revision*)
712 : 1984	Specification for Building limes (*third revision*)
1498 : 1970	Classification and identification of soil for general engineering purpose (*first revision*)
1905 : 1987	Code of practice for structural use of unreinforced masonry (*third revision*)
2248 : 1992	Glossary of terms relating to clay products for buildings (*second revision*)
2720	Methods of test for soils
(Part 4) : 1985	Grain size analysis (*second revision*)
(Part 5) : 1985	Determination of liquid limit and plastic limit (*second revision*)
(Part 26) : 1987	Determination of *p*H value *(second revision)*
3495	Burnt Clay Building Bricks — Methods of Tests
(Part 1) : 2019	Determination of Compressive Strength (*fourth revision*)
(Part 2) : 2019	Determination of Water Absorption (*fourth revision*)
5454 : 1978	Methods for Sampling of Clay Building Bricks (*first revision*)
16993 : 2018	Microfine ordinary Portland cement — Specificiation
17165 : 2020	Manufacture of stabilized soil blocks — Guidelines

3 TERMINOLOGY

For the purpose of this standard, the terms and definitions given in IS 2248 and the following shall apply.

3.1 Fresh Block Density — The ratio of mass of the fresh block (ascertained immediately after ejecting the block out of the mould) to the net volume of the block.

3.2 Dry Density of the Block — The ratio of mass of the dry block divided by the net gross volume of the block.

3.3 Wet Compressive Strength — Compressive strength of the block tested in saturated condition (*see* **8.2**).

4 CLASSIFICATION

The stabilized soil blocks shall be classified on the basis of average compressive strength as given in Table 1.

Table 1 Classes of Stabilised Soil Blocks
(*Clause* 4)

Sl No. (1)	Class Designation (2)	Average Compressive Strength, *min* N/mm^2 (3)
i)	3.5	3.5
ii)	5.0	5.0
iii)	7.5	7.5
iv)	10.0	10.0

5 GENERAL QUALITY

5.1 Stabilized soil blocks shall be manufactured from a uniform mixture of suitable soil-aggregate mixture and stabilizers such as ordinary Portland cement or a combination of lime and ordinary Portland cement. The homogeneous mixture of soil-sand-stabilizer shall then be compacted into a high density block at optimum moisture content.

5.2 All blocks shall be sound and free from cracks, nodules of free lime or other defects which interfere with the proper placing of the unit. Minor chipping resulting from the customary methods of handling during delivery, shall not be deemed grounds for rejection. The faces of blocks shall be flat and rectangular, opposite faces shall be parallel, and all angles shall be square. The bedding surface shall be at right angles to the face of blocks.

5.3 The blocks may be manufactured as per the guidelines given in IS 17165.

6 MATERIALS

6.1 Cement

The cement shall conform to IS 269.

6.2 Lime

Lime shall conform to class C of IS 712.

6.3 Aggregate

The aggregate to be used for diluting the soils shall be aggregate conforming to IS 383. The maximum size of the aggregate used shall be 6.3 mm.

6.4 Soil

Soil shall be of the quality suitable for the production of stabilized soil blocks. Generally, soil contains clay minerals and inert particles such as silt and sand. The percentage and type of clay mineral controls the characteristics of soil. In majority of the cases the clay mineral content of the soil has to be controlled and adjusted by dilutingthe solution with aggregate, in order to make the soil suitable for stabilized soil blocks.

NOTE — A broad guideline to select or modify soil for the production of stabilized soil blocks is given in Annex A.

6.5 Water

The water to be used in the manufacture of blocks shall not be detrimental to its durability. Potable water is considered suitable for the purpose.

7 DIMENSIONS AND TOLERANCES

7.1 Stabilized soil blocks shall be made in sizes and shapes to fit different construction needs. Blocks of special shapes such as rounded corner, corbelled or any other shape for the purposes of enhancing aesthetic appearance of masonry and the building may also be manufactured with special attachments to the mould.

7.2 Dimensions

7.2.1 The modular size of stabilized soil blocks when measured according to the procedure given in Annex B shall be as follows:

Length mm	*Width* mm	*Height* mm
290	90	90
290	140	90
240	240	90
190	90	90
190	90	40

7.2.1.1 The dimensions of the units are so designed that taking account of mortar joints, they will produce wall lengths and heights which will conform to the principles of modular co-ordination.

7.2.2 The following non-modular sizes of the bricks may also be used:

Length mm	*Width* mm	*Height* mm
305	143	100
230	190	100
230	105	75
230	105	100

7.2.2.1 The dimensions of the units shall be measured in accordance with the procedure given in Annex B.

7.3 Tolerances

The maximum variation in the dimensions of the units shall not be more than ± 2 mm.

7.4 Frog

Each block may have frogs on one or both of the bed faces in the form of depressions of rectangular or square shape with depth between 10 mm to 20 mm. In such cases, the area of the frog on each bed face shall be restricted to 25 percent of the surface area and it is preferable to have at least one frog.

8 PHYSICAL REQUIREMENTS

8.1 Dry Density of the Block

The dry density of the blocks, being the average of three specimens, when determined in accordance with the procedure described in Annex C shall not be less than 1750 kg/m^3(17.50 kN/m^3).

NOTE — In order to achieve the specified dry density of the block, the fresh block density shall be controlled by monitoring the quantum of wet mix that is fed into the machine mould.

8.2 Compressive Strength

8.2.1 The blocks, when tested in accordance with the procedure laid down in IS 3495 (Part 1) shall have a minimum average compressive strength for various classes as given in **4**.

8.2.1.1 The compressive strength of any individual block shall not fall below the minimum average compressive strength by more than 15 percent.

8.2.1.2 In above cases the result of the non complying sample shall be ignored and two additional samples shall be tested and result of a set of 4 samples shall satisfying the conditions as per **8.2.1** and **8.2.1.1**.

8.2.2 The actual compressive strength of blocks for use in specific masonry walls may be ascertained from IS 1905.

8.3 Water Absorption

The average water absorption of the blocks when determined in accordance with the procedure described in **4.1** of IS 3495 (Part 2) shall not be more than 18 percent by mass.

8.4 Linear Expansion on Saturation

The linear expansion on saturation of the blocks, being the average of three specimens, when determined in accordance with the procedure described in Annex D, shall not exceed 0.10 percent.

8.5 Weathering

The maximum loss of mass, being the average of three specimens, when determined in accordance with the procedure described in Annex E shall not exceed 3 percent.

9 SAMPLING AND CRITERIA FOR CONFORMITY

9.1 Sampling and criteria for conformity of the blocks for visual requirements (*see* **5.2**), dimensional characteristics (*see* **7**), wet compressive strength (*see* **8.2**) and water absorption (*see* **8.3**) shall be done in accordance with the procedure laid down in IS 5454.

9.2 Out of the blocks which have been selected as per IS 5454 for checking visual and dimensional requirements and have satisfied the above requirements as given in **9.1**, three blocks shall be subjected to the test for dry density of block (*see* **8.1**), three blocks shall be subjected to the test for linear expansion on saturation (*see* **8.4**) and three blocks shall be subjected to the test for weathering (*see* **8.5**).

9.3 For dry density of block, the mean value determined shall be greater than or equal to the minimum limit specified in **8.1**. For linear expansion on saturation and weathering test, the mean value determined shall be equal or less than the maximum limit specified in **8.4** and **8.5** respectively.

10 MANUFACTURER’S CERTIFICATE

The manufacturer shall satisfy himself that the blocks conform to the requirements of this standard and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

11 MARKING

11.1 Each block shall be clearly and permanently marked with the following information:

a) Identification of the manufacturer; and
b) Year of manufacture, if required.

11.2 BIS Certification Marking

Each block may also be marked with the Standard Mark.

11.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(*Clause* 6.4)

BROAD GUIDELINE TO SELECT OR MODIFY SOIL FOR THE PRODUCTION OF STABILIZED SOIL BLOCKS

A-1 A broad guideline to select or modify a soil for the production of stabilized soil blocks is given in Table 2 and Table 3.The soil or soil-sand mixture meeting the specification given in Table 2 may result in production of good quality stabilized blocks. The recommended values of stabilizer to clay ratio for expansive and non-expansive soil have been given in Table 3.

Table 2 Recommended Specification for Soil or Soil-Sand Mixture

(*Clause* A-1)

Sl No. (1)	Details (2)	Ref to, Indian Standard (3)	Limiting values (4)
i)	Granular composition of soil or soil-sand mixture:		
	a) Clay fraction (< 0.002 mm)	IS 2720 (Part 4) and IS 1498	5 to 18 percent
	b) Silt fraction (0.002 – 0.075 mm)		10 to 40 percent
	c) Sand fraction (0.075 – 4.75 mm)		50 to 80 percent
	d) Gravel fraction (4.75 – 6 mm)		0 to 10 percent
ii)	Liquid Limit	IS 2720 (Part 5)	≤ 30 percent
iii)	*p*H	IS 2720 (Part 26)	6.5 – 8.5

Table 3 Recommended Stabilizer to Clay Ratio for Different Types of Soils
(*Clause* A-1)

Sl No. (1)	Type of Soil (2)	Stabilizer to Clay Ratio (by Mass) (3)
i)	For soils having non-expansive clay minerals (for example, kaolinite, illite, etc)	≥ 0.40
ii)	For soils having expansive clay minerals (for example, montmorillonite)	≥ 0.75

NOTE — Stabilizer content should be ≥ 5 percent (by mass).

A-2 Use of soil containing expansive clay minerals such as montmorillonite requires lime as a stabilizing additive to manufacture stabilized soil blocks. Acidic soils having *p*H less than 6.5 can be stabilized with addition of 1 to 2 percent calcium hydroxide (lime) by mass in addition to cement. Soil containing excessive silt fraction can lead to stabilized soil block having very low green strength for handling during the block manufacturing process. In such situations, coarse gravel or coarse sand fraction can be added to the soil to overcome the problem. Some soils may contain deleterious salts or chemicals or organic matter which can impair the stabilization process when cement or cement-lime is used. The behaviour of stabilized soil block using such soils depends upon the nature of salts or chemicals or organic matter present. In such situations, the stabilized soil blocks shall be tested to confirm that they meet the requirements specified in **5.2**, **7** and **8**.

ANNEX B

(*Clause* 7.2 *and* 7.2.2.1)

MEASUREMENT OF DIMENSIONS

B-1 APPARATUS

Overall dimensions shall be measured with a steel scale or metal tape graduated in 1 mm divisions.

B-2 Specimens

Samples selected in accordance with IS 5454 shall be measured for length, width and height.

B-3 MEASUREMENTS AND REPORT

B-3.1 Individual measurements of the dimensions of each specimen shall be read to the nearest division of the scale.

B-3.2 Length shall be measured on the longitudinal centre line of each face, width across the top and bottom bearing surfaces at mid-length, and height on all four vertical faces at mid-length, and the mean shall be recorded.

B-3.3 The report shall show the average length, width and height of each specimen to the nearest 0.5 mm.

ANNEX C

(*Clause* 8 .1)

METHOD FOR DETERMINATION OF DRY DENSITY

C-1 TEST SPECIMENS

Randomly select three full size specimens from the sample of blocks which has been found satisfactory in respect of dimensional and visual requirements. These blocks shall be designated as specimens A, B and C respectively.

C-2 APPARATUS

A sensitive balance capable of weighing within 0.01 percent of the mass of the specimen, ventilated oven or a thermostatically controlled oven capable of maintaining temperature up to 110 ± 5°C and a scale capable of measuring upto 1 mm.

C-3 PROCEDURE

a) Dry the specimens in an oven at 100 ± 5°C to constant mass such that two consecutive mass taken at an interval of 2 h shall not vary by 0.05 percent.

b) Measure the dimensions of the dried blocks (to the nearest millimetre) and compute the volume, in mm^3.

c) Weigh the blocks, in kg (to the nearest 2 g)

C-4 CALCULATION AND REPORT

C-4.1 Calculate the density of each specimen as below:

$$Dry\ Density = \frac{Mass\ of\ the\ specimen, kg}{Volume\ of\ the\ specimen, mm^3} \text{ x}10^9$$

C-4.2 The average of the results for the three specimens shall be reported as the average dry density of the blocks and the result shall be reported to the nearest 1 kg/m^3.

ANNEX D

(*Clause* 8.4)

METHOD FOR DETERMINATION OF LINEAR EXPANSION ON SATURATION

D-1 TEST SPECIMENS

Randomly select three full size specimens from the sample of blocks which has been found satisfactory in respect of dimensional and visual requirements. These blocks shall be designated as specimens A, B and C respectively.

D-2 APPARATUS

A vernier calliper with a least count of 0.1 mm and length more than that of the block, ventilated or thermostatically controlled oven capable of maintaining temperature of 110 ± 5ºC and a length comparator attached with a digital dial gauge having a least count of 0.001 mm (*see* Fig. 1).

D-3 PROCEDURE

a) Cure the specimens for 28 days following the procedure as per **6.8** of IS 17165.

b) Remove the specimens from water and dry them in the oven at 60 ± 5ºC till they attain constant mass such that two consecutive mass taken at an interval of 2 h shall not vary by 0.05 percent and then allow them to cool down at ambient temperature such that they attain room temperature.

c) Measure the lengths of the longest dimensions of all the three specimens using vernier calliper and note them as initial length of the specimens, L_{Ai}, L_{Bi}, and L_{Ci} respectively.

d) Fix a metal point or small strip using water insoluble glue on the top surface of the dried specimens and position the block in the apparatus as shown in Fig. 1. Now, note down the initial reading of the dial gauge at the centre of the metal strip. The readings shall be taken by rotating the block through 90º. The mean value of the perpendicular readings shall be recorded.

e) Remove the specimens from the apparatus without disturbing the digital dial gauge and then soak them in water for 24 h at room temperature.

f) After 24 h take out the saturated specimens and position them in the length comparator apparatus such that the metal point fixed on the surface of the block faces the dial gauge tip. Note the final reading of the digital dial gauge at the centre of the metal strip. The readings shall be taken by rotating the block through 90º. The mean value of the perpendicular readings shall be recorded. Ensure that the dial gauge in the apparatus is undisturbed throughout the duration of test. The difference between the mean initial dial gauge reading and mean final dial gauge reading gives the linear expansion of the specimens, L_{Ae}, L_{Be}, and L_{Ce} respectively, in mm.

D-4 CALCULATION AND REPORT

D-4.1 Calculate the percentage linear expansion on saturation of each specimen as the difference between the initial length and final length after saturation expressed as a percentage of the initial length.

Percentage linear expansion on saturation for specimen A,

$$\mathrm{A} = \frac{L_{\mathrm{Ae}}}{L_{\mathrm{Ai}}} \times 100$$

Percentage linear expansion on saturation for specimen B,

$$\mathrm{B} = \frac{L_{\mathrm{Be}}}{L_{\mathrm{Bi}}} \times 100\text{; and}$$

Percentage linear expansion on saturation for specimen C,

$$\mathrm{C} = \frac{L_{\mathrm{Ce}}}{L_{\mathrm{Ci}}} \times 100.$$

D-4.2 Report all results separately for each specimen and as the average for the three specimens to an accuracy of 0.01 percent.

Linear expansion on saturation (percent) = $\{L_e/L_i\}$ X 100

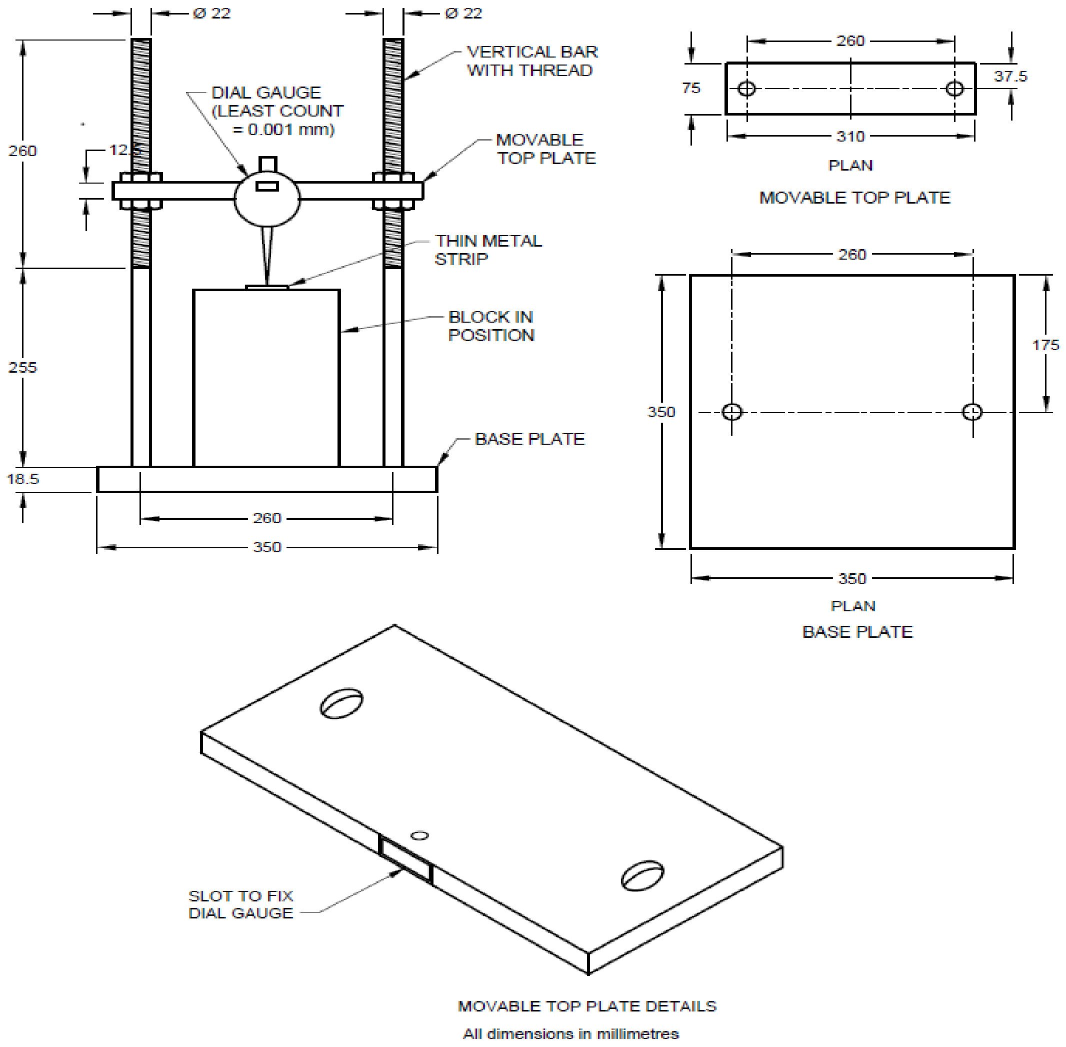

FIG.1 SET-UP LENGTH COMPARATOR

ANNEX E

(*Clause* 8.5)

WEATHERING TEST

E-1 TEST SPECIMENS

Randomly select three full size specimens from the sample of blocks which has been found satisfactory in respect of dimensional and visual requirements. These blocks shall be designated as specimens A, B and C respectively.

E-2 APPARATUS

A sensitive balance capable of weighing within 0.1 percent of the mass of the specimen, ventilated oven or a thermostatically controlled oven capable of maintaining temperature of 110 ± 5ºC and a wire scratch brush made of 0.40 mm diameter wire bristles assembled in 50 groups of 10 bristles each and mounted to form 5 longitudinal rows and 10 transverse rows of bristles on 200 mm × 60 mm hardwood block.

E-3 PROCEDURE

a) Dry the specimens in the oven at 60 ± 5ºC till they attain constant mass such that two consecutive masses taken at an interval of 2 h shall not vary by 0.05 percent.

b) Determine the initial constant mass of the individual specimens and note them as W_{Ai}, W_{Bi} and W_{Ci}.

c) Soak the specimens in water at room temperature for 5 h. Remove the specimens from water and dry them in the oven at 70 ± 5ºC for 42 h. Remove the partially dried blocks from the oven and scratch all the six faces of the specimens twice with wire scratch brush. Hold the brush with its long axis parallel to the longitudinal axis of the specimen or parallel to the ends, as required to cover all areas of the specimen. Apply firm strokes corresponding to 15 N (*see* note below). Approximately eighteen to twenty brush strokes will be required for scratching the wider sides of the specimen twice and four strokes for each end. This procedure constitutes one cycle of weathering test.

   NOTE — The pressure of the brush stroke can be measured by clamping the wider face of the specimen on one corner of platform scale and the scale to zero and putting a standard mass of 1.5 kg on the brush.

d) Repeat procedure given at **E-3** (c) 12 times to complete 12 cycles.

e) After completion of 12 cycles, dry the specimens at 60 ± 5ºC such that two consecutive mass taken at an interval of 2 h shall not vary by 0.05 percent.

f) Determine the final oven dried constant mass of the specimens and note them as W_{Af}, W_{Bf} and W_{Cf}.

E-4 CALCULATION AND REPORT

E-4.1 Calculate the percentage loss of mass of each specimen as the difference between the initial constant mass and final oven dried constant mass after conducting 12 cycles of weathering expressed as a percentage of the initial constant mass.

Percentage mass loss for specimen A,

$$\mathrm{A} = \frac{W_{\mathrm{Ai}} - W_{\mathrm{Af}}}{W_{\mathrm{Af}}} \times 100;$$

Percentage mass loss for specimen B,

$$\mathrm{B} = \frac{W_{\mathrm{Bi}} - W_{\mathrm{Bf}}}{W_{\mathrm{Bf}}} \times 100; \text{ and}$$

Percentage mass loss for specimen C,

$$\mathrm{C} = \frac{W_{\mathrm{Ci}} - W_{\mathrm{Cf}}}{W_{\mathrm{Cf}}} \times 100.$$

E-4.2 Report all results separately for each specimen and as the average for the three specimens accurate to 0.1 percent.

ANNEX F
(*Foreword*)

COMMITTEE COMPOSITION

Clay And Stabilized Soil Products For Construction Sectional Committee, CED 30

Organization	*Representative(s)*
Indian Institute of Science,Bengaluru	Dr B. V. Venkatarama Reddy (***Chairman***)
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Building Materials & Technology Promotion Council, New Delhi	Shri Sharad Gupta Shri D. P. Singh (*Alternate*)
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Member Secretary
Shrimati Divya S.
Scientist ‘D’ (Civil Engineering), BIS

(*Continued from second cover*)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*).’

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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